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QUICK EGGS FOR SELF-SERVICE LINE

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Army Natick Laboratories
Natick, Massachusetts

April 1974

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	Role	Wt
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Egg Product	9	
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By use of a toaster/oven a cooked egg product was developed. This fast method is possible for utilization in a quick self-service line. Various personnel can make use of it for short order cooking in limited areas where there are no adequate facilities for food preparation.

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Cooking Devices	10	
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Toaster Ovens	10	
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Development	8	
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Self-Service Meals	9	
Microwave Equipment	10	
Microwave Ovens	10	
Refrigerating	10	
Military Feeding	4	

	Link C Role	Wt
Dairy Products	7	
Egg Product	7	
Cooked	0	
Microwave	6	
Temperature	6	

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TECHNICAL REPORT

74-50-FL

QUICK EGGS FOR SELF-SERVICE LINE

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FOREWORD

In a recent trial Military Feeding System it was proposed to have prepared short order foods on hand for a self-service line. Evaluation was done on which food products were needed and if these products were acceptable. During the evaluation it was found that egg products needed further consideration. Therefore, this study was initiated to find a method of preparing eggs so that it may be applicable to a self-service line. This study was undertaken under Project No. 1T762713A034, Task 02, Military Food Service and Subsistence Technology.

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ABSTRACT

By use of a toaster/oven a cooked egg product was developed. This fast method is possible for utilization in a quick self-service line. Various personnel can make use of it for short order cooking in limited areas where there are no adequate facilities, for food preparation.

INTRODUCTION

In the trial military feeding system of the Air Force a self-service quick-serve line was incorporated at an airplane hanger. The purpose of this type of service was to provide a means for duty personnel to obtain a meal during hours when regular dining facilities were closed. To do this the Air Force provided a microwave oven, refrigerator and an oven-holding box. There was no means of cooking provided other than microwave.

In this system, food of various types was held from 1 to 8 hours in either of the above-mentioned temperature-controlled units. It was therefore necessary to make some modification of the products to be held. It was found unacceptable to hold fried eggs or any form of egg product in a 150°F. (65.6°C) oven/box for up to 4 hours for a number of reasons.

Literature review

There was found to be little literature directly applicable to this egg holding problem; therefore, a limited bibiography is referenced in this paper.

The proteins of both the white and the yolk are coagulated by heat. Several factors affect the temperature at which coagulation takes place, but in any case the the temperature of coagulation is below 194°F. (90°C). If heated slowly, egg white begins to thicken at 140°F. (60°C) and sets to a jelly at 147°F. (64°C) or 149°F. (65°C). The yolk begins to thicken at 149°F. and will not flow at 158°F (70°C). The combined white and yolk begins to thicken at 149°F. and sets to a jelly at 158°F. to 167°F. (75°C).

When the egg white is heated, the coagulated protein holds within its meshwork the solution of other constitutents and forms a jelly. If heating is continued the proteins begin to shrink until they no longer can hold all the solution, and the jelly begins to exude liquid. The protein in the shrunken state is tough and slightly rubbery. The egg yolk, because of the intimately mixed fat, first becomes waxy when heated, and then mealy rather than tough. Control of temperature is very important in cooking(1).

There was some concern about the microbiology of the egg because of the length of time being held after breakage. Of course, this depends upon the quality of the egg before breakage, sanitary level of egg breaking operation and equipment and the proper holding conditions after breaking and before cooking. Eggs must confrom to the requirements specified in "Interim Federal Specification, C-E-00271H(Army-GL), Egg, Shell". The breaking equipment and operation must meet standards set forthin "Military Standards MIL-STD-667A, Standards for Shelled Egg Plants." It cannot be stressed enough that sanitary packaging is necessary and that the temperature of the egg must not exceed 40°F. (4.4°C) at any time. Eggs which meet the quality and age requirement of any given grade of eggs cited in the above referenced documents should minimize the rate of microbial spoilage.

It is noted that the content of the egg white has its own anti-microbial agents present: Egg white is reported to inhibit bacterial growth because of its content of the enzyme lysozyme, which dissolves the cell wall of grampositive bacteria; of avidin, wheih ties up biotin; of ovomucoid, which is antitryptic; and conalbumin, which chelates iron and thus prevents the growth of bacteria at high pH.(2).

The vitelline membrane is the main protection of the yolk of a broken egg, but it is considered a weak carrier. The yolk is recognized as an excellent growing media and in fact can even be used in cultured media, therefore, the yolk is the limiting microbiological factor. It is for this reason that broken-out eggs in the container be held at 40°F. or lower for not more than three days.

Most of the applicable cooking theory was obtained directly from Dr. W. J. Stadelman.

Materials and Methods

Grade A large eggs were obtained from a local market. Preliminary work was done by placing raw, partially cooked and fully cooked eggs in 4-ounce aluminum trays. These were then covered and placed in a 150°F. warming oven. They were checked for quality at 1,2, and 3 hours.

A General Electric toaster/oven (Trademark Model T93B) was utilized in the cooking of the egg type products. By utilizing normal toaster setting, proper cooking to the correct doneness was obtained at different times.

Black paint was applied to 4-ounce aluminum trays 3-1/2 inches in dia. and allowed to dry. This was to help facilitate the uptake of the radiant energy produced by the coils. To determine the amount of coating that would be the most beneficial, the following was tried: One tray was painted on the bottom and sides, another on just the bottom and one was not coated. Eggs were placed in all trays and cooked for two minutes and forty-five seconds.

It was alos suggested that a painted cover as well as the trays would help in the absorption of the heat and therefore cut the cooking time. Holes were punched in the cover to release the steam while cooking.

It was found to be necessary to coat the insides of the trays to avoid sticking of the egg to the tray. Use of liquid paraffin did not appreciably remedy the sticking problem. Liquid and stick margaine was then tried.

Microwave cooking was also attempted.

All previous wxperiments were conducted with room temperature aluminum trays. It was thought advisable to hold the egg in the tray overnight at refrigerator temperature (40°F.) to see if there would be any significant time changes.

In the course of the various trial runs, it was determined that the following procedures yielded the desired objectives. Eggs were placed in aluminum trays without covers and than placed in the toaster/oven at room temperature. Times for cooking were found to be as follows:

1. Soft-fried (sunny-side up); white not completely solid - 2 min. 30 sec.

2. Hard-fried; solid white, but runny yolk - 2 min. 45 sec.

3. Hard yolk-fried; with yolk membrane broken before cooking - 2 min. 45 sec.

4. Soft to medium cooked scrambled eggs: 2 min./45 sec.
   An egg was placed in a bowl, whipped with a fork and poured in an aluminum tray. After cooking in the cooled toaster/oven - it was removed and stirred.

5. Hard-cooked scrambled egg; Cooking time was 3 minutes
   The egg was placed in a bowl, whipped with a fork and poured in an aluminum tray. This product had the resemblance of an omelet product,,which creaded interest in expanding into a cheese, a ham and/or a ham and cheese omelet.

An egg was broken into a bowl, whipped with a fork and placed in the aluminum tray. One tablespoon of cheese, ham or ham and cheese was mixed with the egg. Cooking time again was 3 mins. in a cool toaster/oven.

RESULTS AND DISCUSSION

1. After the initial literature review, the assumption could be made that in the most simple manner, an egg could be in a 150°F(66°C) oven and cooked to the desired doneness. However, for the maximum of holding time needed in the serving of the cooked egg (up to four hours) the product would not be acceptable from the standpoint of texture, i.e., rubbery. After one hour exposure at oven temperature, no quality detects observed with the partially cooked product. The uncooked egg eas still partially raw, while the fully cooked egg was becoming rubbery. After 2 hours of holding, only the raw egg was acceptable. The other two were progressively becoming rubbery and tough. After three hours, none was acceptable.

2. Black paint or a coating of some heat resistant type was found to facilitate faster cooking. As suspected, the tray without any coating required longer cooking time, as much as, 15-20 seconds. The tray with coating on the side had more burning of the edges. This extra browning was thought to be undesirable. Therefore, the coating is considered to be only necessary on the bottom of the trays.

3. Covering the product during cooking was not found to be necessary because cooking time was of short duration.

4. Liquid or stick margarine, or any other type of vegetable shortening may be utilized in the product to avoid sticking. Margarine was found to add to the flavor of the product.

5. Microwave cooking was found to be generally unacceptable for the type of products wanted, due to the development of toughness and other undesirable characteristics.

6. Temperature of the aluminum trays did not effect the cooking time of the product.

7. Of course, original oven temperature has a large effect on cooking time. A warm oven can cut the cool oven cooking time by as much as one minute.

8. By contacting the General Equipment and Packaging Laboratory at this Laboratory it was found that black epoxy coating aluminum trays have been used in heating studies in the past. Coated containers can be obtained from any aluminum packaging manufacturer.

SUMMARY and CONCLUSION

Since egg cookery and holding warm before serving is very sensitive to the proper texture quality of an egg, a different method of cooking was needed. This method of cooking utilized already existing equipment and provided an egg with acceptable texture quality.

A four-ounce aluminum tray package with a bottom coated with a heat resistant black coating seemed to provide the best means of cooking for these products. Even though this package was efficient, it may not have a good eye - appeal to the consumer. Therefore, the package may need only be used for cooking.

The author of this paper thinks this method may provide a reasonable way for serving egg products in a limited short order cooking facility.

TABLE 1. - Length of Time Required for Cooking of the Different Products on Toaster Cycle

Product	Time(minutes)
Sunny-side up	2-1/2 - 2-3/4
Hard fried	2-3/4
Scrambled, soft	2-3/4
Scrambled, hard	3
Omlet, ham	3
Omlet, cheese	3
Omlet, ham and cheese	3

RECIPES FOR EGG PRODUCTS

FRIED EGG

Ingredients:	Percent	Ounces	Grams	Methods
Margarine, butter or shortening (1/2 tsp)	1.96	0.04	1	Melt and spread in side of container
Egg, whole, grade A Large	98.04	1.76	50	Break egg into container. Seal Container.
	100.00	1.80	51	

SCRAMBLED EGGS

Ingredients:	Percent	Ounces	Grams	Methods
Margarine, butter or shortening (1/2 tsp)	1.96	0.04	1	Melt and spread inside container.
Egg, whole	98.04	1.76	50	Beat egg just enough to blend yolk & white; either in container or some suitable bowl. Place egg in container and seal.
	100.00	1.80	51	

RECIPES FOR EGG PRODUCTS

CHEESE OMELET

Ingredients:	Percent	Ounces	Grams	Method
Margarine, butter or shortening (1/2 tsp)	1.72	0.03	1	Melt and spread inside of container.
Egg, whole Large	86.21	1.76	50	Beat egg just enough to blend. Use container or other suitable bowl.
Cheese, cheddar (1Tbsp) ground or shredded	12.07	0.25	7	Place eggs in container, mix in cheese. Cover
	100.00	2.05	58	

HAM OMELET

Ingredients:	Percent	Ounces	Grams	Method
Margarine, butter or shortening (1/2 tsp)	1.72	0.03	1	Melt and spread inside of container.
Egg, whole Large	86.21	1.76	50	Beat egg just enough to blend. Use container or other suitable bowl.
Ham, canned, chopped (1 tsp)	12.07	0.25	7	Place eggs in container; mix in ham. Cover
	100.00	2.05	58	

HAM/CHEESE OMELET

Ingredients:	Percent	Ounces	Grams	Method
Margarine, butter or shortening (1/2 tsp)	1.54	0.03	1	Melt and spread inside of container.
Egg, whole Large	76.92	1.76	50	Beat egg just enough to blend. Use container or suitable bowl.
Cheese, cheddar(1Tbsp)	10.77	0.25	7	Beat egg enough to blend. Use container or suitable bowl.

Ingredients:	Percent	Ounces	Grams	Method
Ham, canned, chopped (1Tbsp)	10.77	0.25	7	Place eggs in container; mix in cheese and ham. Cover
	100.00	2.30	65	

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1. US Department of Agriculture. 1941. Eggs and egg products. (Circular 583). US Government Printing Office.

2. Frazier, W. C. 1967. Food Microbiology. 2nd Ed. McGraw-Hill Book Company, New York.